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How the WORLD BECAME

BY ERNST H. KRELL





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How the
WORLD BEGAN

UNIFORM WITH THIS VOLUME

HOW THE WORLD GREW UP

The Story of Man

HOW THE WORLD IS RULED

The Story of Government

THE WORLD OF ANIMALS

The Story of Animals

THE GARDEN OF THE WORLD

The Story of Botany

HOW THE WORLD IS CHANGING

The Story of Geology

THE WORLD'S MOODS

The Story of the Weather

THIS PHYSICAL WORLD

The Story of Physics

WHAT MAKES UP THE WORLD

The Story of Chemistry

OTHER WORLDS THAN THIS

The Story of Astronomy

..

THOMAS S. ROCKWELL COMPANY

Publishers

CHICAGO

TO MY GRANDFATHER

*Hoping that I
may take after
him as all the
prehistoric
creatures in
this book took
after their
grandpas*



*Early man had to be strong and quick in order to
live at all*

HOW THE WORLD BEGAN

By
EDITH (HEAL) *Berrien*

Drawings by
DON NELSON



THOMAS S. ROCKWELL COMPANY
CHICAGO
1930

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THE WORLD GOES TURNING

The world goes turning
Slowly lunging,
Wrapped in churning
Winds and plunging
Rains. The land
And the waters turn.
The mountains stand
Solid and stern.
But the rivers slide
Gently in valleys.
Lithe fishes glide
In their cold alleys.
And there are creatures
Of various forms
And various natures.
Rosy worms
Wallow at dawn
In pools of dew.

And the churning, braying
Waters lash,
And a star floats burning,
And clouds crash,
And the world goes turning.

—GEORGE DILLON.

From "Boy in the Wind."—Viking Press.

||

Publishers' Note

This book presents in popular form the present state of science. It has been reviewed by a specialist in this field of knowledge. An excerpt from his review follows:

"This simple and entertaining book gives a fine picture of the beginning of life on our earth. It is scientifically accurate. It should stimulate and thrill every reader."

||| Signed: ADOLF CARL NOÉ

*Associate Professor of
Paleobotany*

*The Department of Geology and
Paleontology
The University of Chicago*

*Where did the
world come from?*

CHAPTER I

IN THE BEGINNING

THE world was hurled out of the sun. For billions of years the sun has been tossing fiery masses into the air. These masses, like flaming rockets, travel hundreds of miles trailing clouds of brilliant mist. After a while they go back to the sun just as the far-flung spray of a fountain returns to it again. The force that brings the masses of fire and gas back to the sun is called *gravity*. It is a pulling force that belongs to all bodies and is greater in larger ones than in small ones. Gravity gives the sun, and other bodies of the heavens, the power of a magnet. Everything within reach of the magnet is drawn down by it, and everything that leaves it must return. This is why tennis balls don't fly away and why we fall down instead of up.

So like the other fiery masses, the world was born of the sun. But unlike them, it did not go back and become a part of the sun again.

It was thrown from the sun with great force. It shot up very quickly, traveling more miles a minute than a bullet. The farther it went, the weaker was the sun's hold on it. By a strange chance it soared straight toward a passing star which possessed great gravity too. Although the passing star was not as great a magnet as the sun, it was near enough the earth to influence it. It pulled the small body of sun-fire to the extreme edge of the sun's reach. There the earth stopped. It did not fly off into space because, though the sun had not enough power at this distance to pull it all the way back, the parent was still powerful enough to hold on to the runaway. The earth was kept in a certain path by the sun's gravity.

Yet it did not return to the sun. The passing star had given it a "running start" in its race away from the sun. This pulling of the earth in one direction while the sun pulled it in an-

other, made a perfect balance. The earth stood still. It moved neither nearer nor farther away. It was like a tug of war with both sides evenly matched. Neither side won or lost.

And so the sun controls the earth but it can never make the earth return to it and become a part of its fire again. Like a child who wandered too far away and could not find its way back, the earth—attracted by the passing star—followed it and was lost from the sun forever.

When the earth first left the sun, it was a hot glowing mass of gaseous material. It must have looked like a balloon that had caught on fire as it floated through space. But as it traveled along by itself it lost its heat. The flaming bolt cooled quickly and the fiery clouds surrounding it turned into many hard small bodies like hailstones which were called *planetesimals*. The planetesimals swarmed about the cold mass of the earth like countless bees around a hive. The cold mass that formed the central core of the earth was small—perhaps about a tenth of the size the world is today. But this mass was

What was the earth like in the beginning?

destined to grow bigger. Like its parent, this child of the sun possessed the marvelous force of gravity. The larger it grew the more gravity it had. The earth became a powerful magnet too. It gathered in all the planetesimals around it. It pulled down the shooting stars, the masses of fire that the sun tossed within its reach, and all the other wandering bodies of the heavens that came near it. Whether this very young earth had air or not depends upon how large it was. Perhaps the first core of earth was so small that, like the moon, it did not have enough gravity to hold atmosphere, or perhaps like the planet Mars, it could only hold very thin gases near its surface. Without air, the earth would have remained barren and lifeless. The brilliant burning sun would have shone upon it undimmed by clouds and atmosphere. The nights would have been freezing because no blanket of air held in the heat after the sun went down. Who could have lived on an earth that swayed between a temperature that was nearly to the boiling point and one 200°

or 300° Fahrenheit below zero? This is what would have happened if the earth had not increased its gravity so that it was great enough to hold air and water on its surface.

But during the growing stages, it gathered in more planetesimals and enlarged its diameter from several thousand miles. The surface gravity became strong enough to hold atmosphere and heavier and thicker layers of air hung over the earth. The planetesimals that struck the surface freed certain gases that were added to the air, and later when volcanos began to erupt more gases poured forth into the ever-increasing atmosphere. For a long time planetesimals showered down on the earth. It grew larger because of all the planetesimals falling on it. The weight of these added bodies pressing down upon the earth made it warm inside, and the uneven way in which the planetesimals fell on it made it rough and uneven outside.

Along with the other things the earth pulled down upon itself was the moisture it drew from

How were the oceans and continents formed?

the clouds. This moisture gathered the fine dust of broken planetesimals from the air and brought it to earth. There the dust helped build up the land. In those places where there was little rainfall, no dust fell and the earth remained low.

As the earth grew, it collected more water. The water came down and filled all the hollows and crevices on the uneven surface. Pools were formed like the pools that fill the ruts in the road after a recent rain. But these were giant pools called oceans. As the water ran down into the cups and basins of the earth, it left the higher lands dry and they were continents.

Why didn't the water wear away all the land?

When the earth began to pull the moisture down upon it, it seemed for awhile as if it might some day be completely covered by the oceans. There was a danger of the land wearing away. Parts of the continents were washed into soil and carried by the streams into the ocean. The waves washed away the shores. The continents were cut lower and lower. If the land had vanished entirely all living things that could not

exist in water would have died. The world would have been a strange sea-country inhabited by fish-like forms and water plants. But fortunately before the land was completely worn away, the ocean began to sink lower too. This was because the land that had been washed into the sea had made the ocean bottoms heavier. The weight pushed down the basins that held the waters. At the same time the land became lighter. The sinking ocean basins squeezed the continents higher. And land was saved for life.

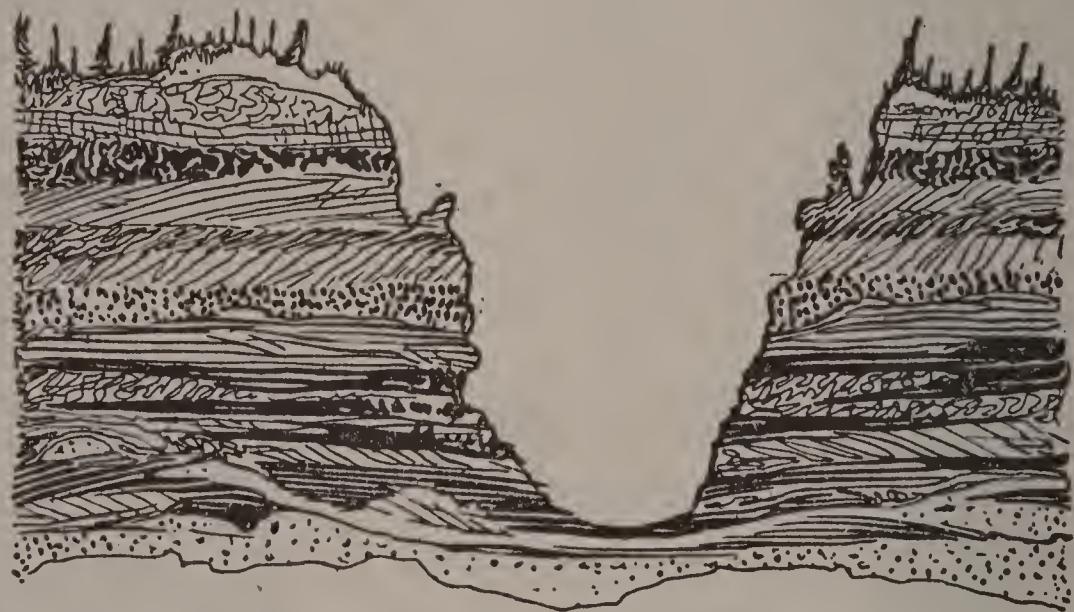
The earth is like an old, old man who has forgotten how long he has lived and sits silently by while people try to guess his years. There is no exact way of knowing how old the earth is, but three ways have been found to give us an idea of the billions of years it has lived.

How old is the earth?

One way is to measure the salt in the sea. The streams of the earth carry the salt to the ocean. If we find out how much salt is brought every year and how much is in the ocean altogether we can divide the larger figure by the smaller

one and the answer will be the number of years this process of salt-carrying by the rivers has been going on.

Another way is to look at the rocks of the earth. We would find that the rocks are in layers, one on top of another. If the thickness



The rocks are in layers which can be seen easily where rivers have cut their valleys

of these layers of rock is measured, and we can find out how long it takes for a layer to become that thick, then we know how many years it took to build up all the layers that we know are in the earth.

The third way is to examine the oldest rock in the earth, which contains a substance called radium. Scientists know that as years pass the radium changes into other substances and in the end turns to lead. We can watch how long it takes for a tiny part of the rock to turn to lead, and then we can tell how long it took for all the lead in the rock to form. And so if we can find out the age of the rock by the amount of lead in it, we will have some idea of the age of the earth.

Up to the present time no scientist has been able to tell the exact age of the earth, though they can tell surely that it is very old, certainly billions of years. Thus far, like the old, old man, the earth keeps silent and lets men go on guessing its years.

The earth was ready for life. The harshness of too great cold, and too great heat, was gone, and the temperature was just right. There were great seas and inland streams. Everything necessary for life was present. So, with everything prepared for it—life began.

What was the first living thing on earth?

No one knows when; no one knows how—its beginning is a mystery. And we do not know what the first living thing was. We only know that it came into a strange world—a world empty of trees and flowers and grass and overhung with silence. There was nothing to make a noise except the slow-moving waters. It must have seemed like a world that was dead—or not yet born.

The air may have been so thin that large creatures could not have breathed, and the first life must have been tiny creatures that did not need lots of air. Perhaps we shall never know what the first living things were, for they did not leave any fossil record of themselves for us to study the way the later creatures did. They may have been too soft to leave an impression on anything they touched. If the fluff of a dandelion gone to seed fell on the damp ground it would not leave a mark. Perhaps the first living things were as light as that.

Whatever they were, they probably did not look like anything we know about today. They

were perhaps neither plant nor animal but something which was to be the beginning of both forms of life.

Living things stay where they have the best chance to continue life. The early creatures of the earth must have made their homes where it was easiest for them to live. It was probably not the ocean. The seas were too vast and restless. The life elements, which were probably different kinds of chemicals, were scattered and diluted with water. They lost some of their strength just as fruit juice mixed with water becomes milder tasting.

But along the shores of the oceans the soil was soft and muddy. The life elements were brought close together. There was no rushing current and tide to scatter them. It was probably here that the first life made its home. These tiny things could burrow into the soft soil and still feel the warmth of the sun. But what these brave little pioneers were we can only guess. They remain the greatest mystery in the world.

So life began—a breathing pulsing thing that

Where did life start?

was to develop in slow stages through an endless passage of time. Why it began we shall never know. We can only see that the earth had become fit to house living creatures.

Time was to bring many changes of the lands and seas and climates. Life took new forms to meet the new conditions that arose. Strange creatures walked the earth, giving rise to new types and classes of beasts and fishes. The mystery of life had begun and has not yet come to an end.

CHAPTER II

THE STONE BOOK

THE earth has written its own story. Like all the books in the world it cannot tell everything. Like all very old books, this book of the earth has missing pages. In places the words are dim or in a language men have not yet learned to understand. But the book is there—a thrilling story of strange and mysterious things, of living creatures so small they have to be imagined, and of monsters the like of which we shall never see alive.

What tells the story of the earth?

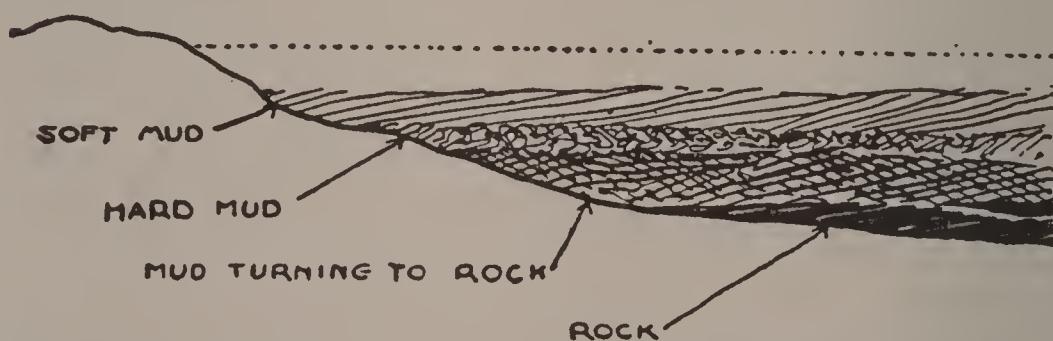
The pages of the book are the layers of rock that lie one on top of another beneath the surface of the earth. When a layer of rock was worn down, or washed away, it meant that a page of the book was lost forever and with it was lost a part of the story of life. It took countless ages to make each page of the Stone Book. The first chapter is the bottom layer of

rock. The streets we walk on mark the last thing recorded in the book the world is building.

Why are there layers of rock?

The surface of the earth has passed through many, many changes. We know the sea ate away the land and the water wore away the earth and the soil was carried into the seas by the streams, because this is happening today:

The fine earth carried by the water slowly sank to the bottom of the sea. It covered up the bodies of dead sea life that had also sunk



Mud at the bottom of the seas slowly turned to rock from the pressure of water

to the sea floor. Thus a layer of earth buried a record of the past. Shells and other lifeless forms were made prisoners in the rock. But it took thousands of years for a few inches of this layer to form.

More earth was carried to the sea bottom, and the first layer was covered up. The process went on, and as new sea creatures died and fell to the bottom, new mud covered them up, for ages and ages. Creatures that were soft and boneless and without shells vanished forever, but all those that were something more than a mass of mere jelly, were preserved in the layer of soft and yielding soil.

New lands were being formed. The dust from the heavens came down and made a new earth surface. Land was pushed up by the sinking oceans. What was once ocean bed became land, and what was land sometimes became an ocean bed.

The buried land, at first nothing but soft mud, became harder and harder as the weight of new lands pressed down upon it. Sometimes the underground waters brought it cement-like materials that changed it from a wet and soft substance into a hard and rocky one. And after many years it no longer was like the material it had been when it formed the top of the

world. It had turned to rock. This rock did not always remain at the bottom of the sea because the earth kept lowering its surface.

Layer after layer of this rock was formed. The oldest layers were the bottom layers, and so the story of the earth reads backwards.

What is a fossil?

The soft forms of life were lost when they died, but others were hidden like buried treasure in the layers of rock that once were soft mud. Still others vanished, but left some sign that they had once been there, as a flying sea bird will leave the mark of its wings and feet in the sand before it takes up its flight again.

These remains of early animals and plants, as well as the traces and signs they have left, are called fossils. It is these fossils that make the Stone Book interesting to read, for they are like the pictures in a real book. And as Alice in Wonderland said, "What is the good of a book without pictures?" Without fossils the story of the world would have been very dull. It would simply have been a story of what the land did to the water and what the water did

to the land. The marvelous story of life would have been left out.

We do not always know what caused the death of the creatures whose forms are saved for us in the shape of fossils. But we do know that even today, earthquakes will sometimes kill great numbers of living creatures, just as dynamiting a lake will kill every fish in its depths. Such things as earthquakes have been happening all through the life of the earth, and when large numbers of living things were killed at one time the chance of having a fossil record was good.

The most perfect fossil is the actual remains of the animal or plant. When this fossil is uncovered it looks exactly the same as when it was first buried. It has to be chipped out of the stone, which was only mud when it covered up the dead thing. Instead of changing its form the earth preserved it perfectly.

The most wonderful example of the earth preserving a dead creature is that of the great Siberian Mammoths. These enormous animals,

What are fossils like?

like hairy elephants, were frozen in the arctic ice, thousands of years ago. So, in a natural cold storage, they were preserved. Even the flesh was kept in condition down to recent years and it could be fed to dogs.

Thousands of ants and tiny insects have been found in perfect condition embedded in amber, which is a fossil gum of certain old trees. The insects crawling along the bark of the tree were caught in the sticky resin and were preserved there when the resin hardened into amber. This is the same amber that is the honey colored stone used in jewelry.

At least one prehistoric rhinoceros was found in nearly perfect condition in soil near an oil field. But this complete preserving of the bodies of animals that died thousands of years ago is a rare thing.

Of course bones and teeth are found because they are hard and do not easily decay. If they were buried in lakes or pools that contained asphalt, they were perfectly preserved. Thousands of bones have been found in a great tar

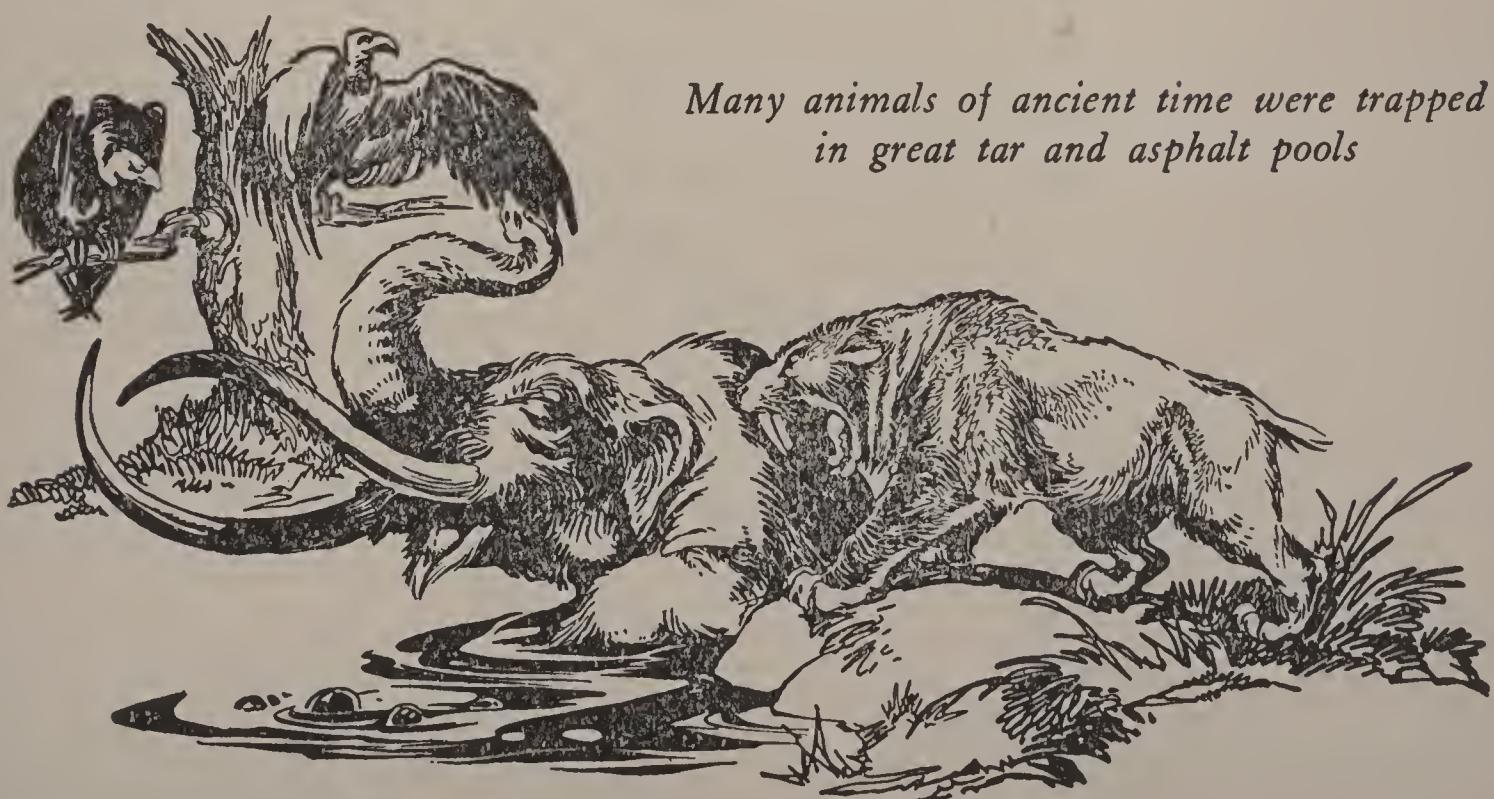
pool in California, where many animals were trapped ages ago. The animals were caught in the pool just as quicksands will catch unwary animals today. Scientists have found the bones of a hundred different animals in this great pool—a thrilling sort of buried treasure that tells the story of the life that lived here before the coming of man.

Other fossils are like stone. In fact they are stone, for time has turned these things to rock, and in place of the actual skeleton or form of the dead thing, we have a stone shape exactly like it.

This turning of things to stone is like some fairy tale where a magic spell is cast which changes all things to rock. Even trees have been turned to rock, and become like stone statues. The trees still have their gnarled

What is "turning to stone?"

Many animals of ancient time were trapped in great tar and asphalt pools



trunks, but instead of soft bark they are made of cold slippery rock. The shells of ancient clam-like animals are found today turned to a brassy mineral.

This "turning to stone" is caused when certain waters moving through the earth come to



There are petrified forests where the trunks of trees have been turned to stone

the buried form. The waters gradually wash away the animal or vegetable matter, and leave in its place some mineral matter like quartz or common limestone.

Sometimes the very rocks themselves are made of fossils. Chalk is an example. It is composed almost entirely of very tiny sea animals. The skeletons of these animals are made of a soft white stone. Certain kinds of limestone are made up of thousands and thousands of shells, that came from some clam or snail-like form, all cemented together by the action of the water.

There is "More than a stone's smooth sightless face" in the looming chalk cliffs and the lime pits. There are the millions of lacy skeletons that tell the story of life in its earliest forms, a life that has always been born to die.

Only the sea is without footprints. Wherever land has been are the tracings and impressions of the passing of living things. This third group of fossils is the most picturesque and mysterious of them all.

What is the "mark of wings?"

There is the imprint of a dragon-fly's wings found stamped on ancient stone. What is this besides just a "mark of wings?" It is an accurate picture of a lost form of life, of something

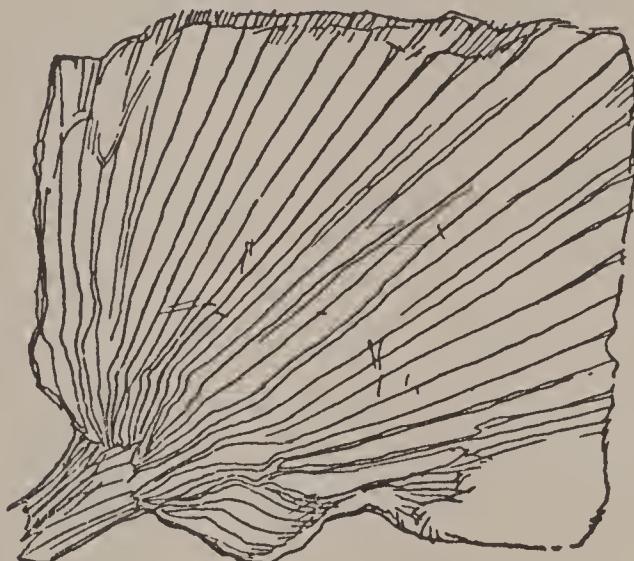
we shall never see. It is a more perfect drawing than the cleverest artist could make. It helps tell the story of the world just as surely as the more perfectly preserved bodies do.

There are all kinds of impressions. There are dark streaks and dots that might have been the trails and borings made by worms. There are fantastic outlines of strange fish. There are immense footprints that tell of giant animals walking the earth. The fossil that is a mere impression was usually made in a soft mud bed where it was easy to leave a mark. Here a leaf might drop, leaving its delicate tracery—or shell—or feather—or bone, to have its impression harden with the mud into stone and be recorded forever as surely as if it were housed in rock.

What are moulds?

Why is it that people still shudder at the thought of the volcano Vesuvius? They cannot forget the tragic fate of the city of Pompeii which in one sense became a fossil city. At the time of the eruption of Vesuvius, an outburst of lava carried ashes into the air. They were shot high in the atmosphere and showered down

upon the earth like a hot rain. They buried all things beneath them. The volcanic ashes covered the bodies of living things. Centuries later the ash coverings remained but the bodies inside had disappeared. By filling the hollow



The fossil of a palm leaf is a print in stone—once mud—of the leaf itself

space where the bodies had been with plaster of paris, perfect casts were made of the original forms preserved so strangely from the past.

Moulds are also made in quieter ways than the volcanic eruption that has gone down in history. The hole that a worm bores in the ground—or any impression left on the earth—

may be filled with mineral matter. A mould is made which preserves the form but not the actual structure of the creature. In this way many soft jelly fishes were preserved.

CHAPTER III

THE FIRST FISH

THE creatures of the early seas that had no hard shells to be preserved, left silhouettes on the sands. There are worm trails to tell us of the passage of soft-bodied creatures.

Other impressions and moulds tell of queer sponges and jelly-fish. The shell-covered creatures were imbedded in sand and became fossils. They are found today looking nearly the same as they did long ago. Records tell of snail-like beings, of clam-like creatures and of the important early ancestors of scorpions and king-crabs, which were crab-like forms with many legs and hard shells. Star-fish, ancient coral, sea-anenomes and countless other strange shelled forms have had their stories told by fossils.

These early sea creatures lived a lazy life, burying themselves in the mud or clinging to wet rocks. For the most part they were little

*What were the
earliest creatures
to leave a record?*

more than ugly moving masses—many of them headless. They probably knew or felt nothing of what went on about them—the warm moist air, the thick mists that hung over the sea, and a world of stillness broken only by the crashing of tempests and volcanic eruptions.

What came before fishes?

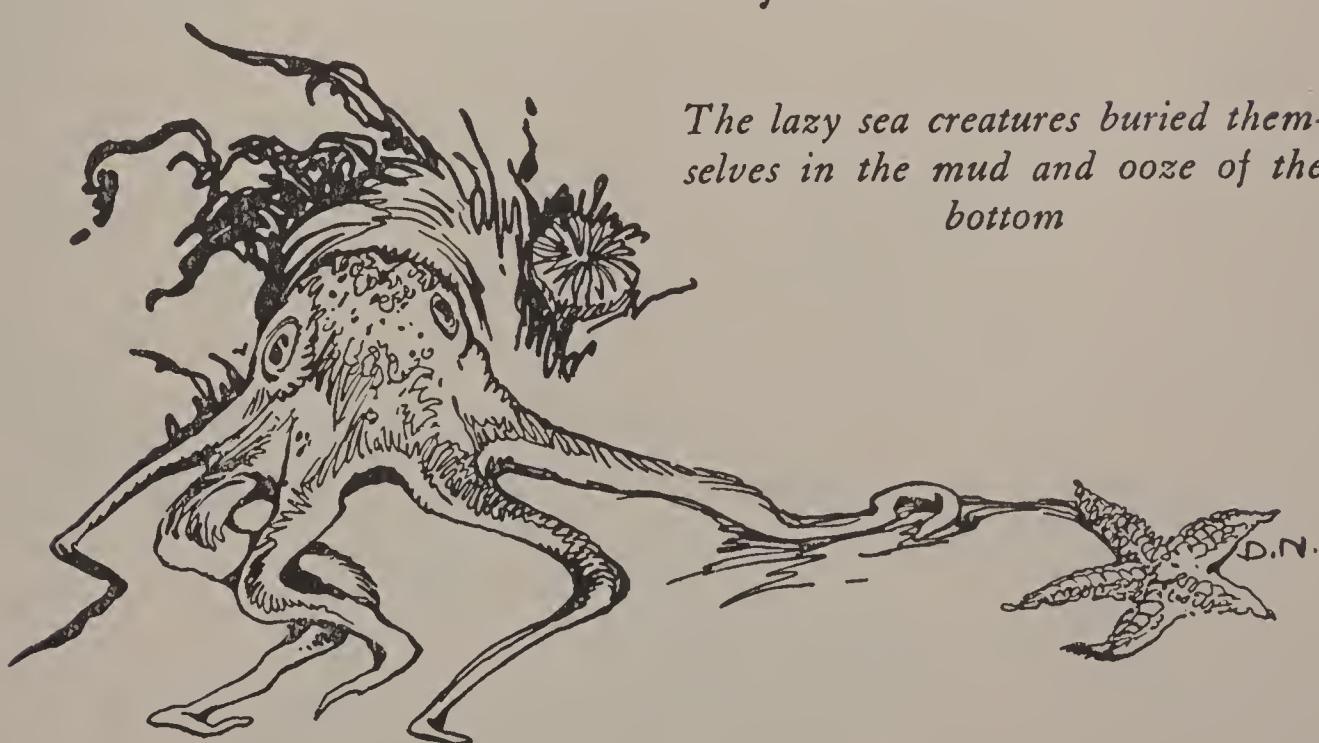
And now the lazy world of mud creatures gave way to the more troubled times connected with life in the ocean deep itself. The pale jelly-fish and the star-fish continued to bury themselves in the mud but the new creatures ventured into the dangerous sea itself. The newcomers differed from the soft and sleepy forms that already existed, in one all-important way. They possessed the beginnings of backbones. It is true that these were not made of bone but of a gristly cartilage.

To this day men refer to those content to sit back and do nothing as “having no backbone.” One with courage and endurance “has backbone.” The first creatures to possess a backbone—or what was like it—were the first ones in the world to show the truth of the saying. These

small fish-like animals were completely covered with a bony armor. The armor plates that they wore were to protect them in their fight for life. Certain of these shell-skinned types were to give rise to true fishes. But these first forms were little like the true fish that soon followed them. They sometimes had paired fins and a mouth, but no real jaws. They were small and slender—some measuring about seven inches in length.

But even with the appearance of these creatures with gristly backbones, there was little flash or glint of swimming bodies in the ocean. The first fish-like forms stayed close to the sea-floor and spent long periods of time floating and drifting along. They were only a very little more active than the forms that lay in the mud.

The lazy sea creatures buried themselves in the mud and ooze of the bottom



But at least they had ventured into the open and were ready to defend themselves with their strange coverings of bony armor.

What was the first true fish like?

The first true fish had a shark-like form. Fossils prove that it had a well-developed backbone. It had a long slender body compared with the early sea-creatures that spent so much time lying in the mud. Some scientists think that the fish became long by resisting the push of the water. Its backbone helped to do this. The biggest of these shark-like fish were an astonishing jump in size from the little armored creatures that came before. They were from two to five feet long. They had paired fins and biting jaws with teeth. They became the pirates of the waters for their fins made them better swimmers than those with little or no fins at all, and their sharp teeth made them able to devour coarser and tougher foods. This first shark-like form soon disappeared—but it had offered its gifts to living things—paired fins and tooth-bearing jaws had come into the world. Legs and heads were to come from these in time.

The bony fish is the ancestor of most of the fish that live today as well as the distant forefathers of land forms of life. It made its appearance very soon after the shark-like fish and was probably related in some way to it. The great and different thing about this new fish was, of course, that it had a skeleton of real bone. The bony fish was a shining traveler of the waters. Its bony-covered head and the bony coat of mail

*What was the
bony fish?*

*Soon there were fish that had plates of bone to
protect their soft bodies*



that protected the rest of its body was coated with a glistening substance that made the fish gleam in the water.

*Who were the
giants among the
early fish?*

The giant fish of the very early times is a mystery. It had no bony skeleton so we cannot tell very much about it. But this we know—that these great and fierce creatures were from ten to eighteen feet in length and had powerful jaws and armored heads. They surged through the deep, pirating among the other sea-creatures. They could devour anything they saw for they were the biggest living bodies in the world.

*What were the
lung-fish?*

The bony fish began to develop lungs which kept them alive when the pools they lived in became stagnant and the fish had to breathe air. From the early bony fish with lungs came other forms, and related to one of these was the true “lung-fish.” In some of them the lung became so highly developed, that the fish could still live when the pool dried up completely.

CHAPTER IV

THE FISH THAT WALKED

SO FAR a desolate land had looked on the thickly populated waters. Only the shores of the sea had seen life. Inland the silence hung heavily over the earth. There were no bird calls in the strange fern-trees. No creatures hid among the tall weeds. The land was empty of life. Until one day a fish walked on to the shore of the sea.

How did the fish get ready to leave the water?

One of the fish-forms had acquired lungs that were capable of breathing air. The new fish had developed in other ways as well. Their backbones had changed from skeletons of cartilage and gristle to sturdy bone that would support a body out of water. Certain of these fish had grown pairs of fins with strong bones that were not unlike limbs. The fish was ready to leave the water. It was possible for it to live out of water because of its air-breathing lungs.

It could walk as well as swim because its strong fins could move beneath its body like legs.

And so the time came when the first of a great line of walking creatures rose out of the sea. Later the fin that walked was to appear as a real foot that left its track on the uninhabited lands.

Why did the fish come on to the land?

The scene is a little tepid pool, drying inward from the edge. As long as the pool contained some water and was merely stagnant the bony lung fish could still survive. But as soon as there was a possibility of it drying up completely, the water-bred fish were in danger of dying. Some could live a little while by burrowing in the mud, but sooner or later they perished. The more ambitious lung-breathing fish—instead of lying in a sluggish torpor—left the dried-up pools and ventured into the new world on land. Many were to meet their death there—but they had accomplished the most dramatic event thus far in the history of life. A fish had walked and a fin was soon to become a real foot!

Like all first steps, this one was probably as unsteady as the first steps a baby makes. The paired fins that walked were very weak. And yet they were able to make the first step in the story of the world.

What was the first step probably like?

Closely following the fish that walked and related to it in some way, was a fish-like form called the "*amphibian*." The principal difference in its form was that it had legs instead of fins. They were very weak legs, however, and short like a seal's flippers. The amphibian must have crawled along slowly on his clumsy spraddling limbs. Like the walking fish, when the amphibians discovered the pool they lived in was drying up completely, they set bravely forth to discover another pool. Probably they came on land in order to get back into the water again. The step ashore probably saved the amphibian's life for it became used to the land and after that could live just as well in seasons when the waters dried up. But the amphibian never became a land animal completely. It was probably the first misfit in the world. It

What was the first land-dweller?

belonged to the water and outgrew it. And it soon discovered it was not wanted on the land. The amphibian continued to lay eggs in its water home and its young drew their first breath through gills. But soon lungs developed and the children followed their parents onto the dry land to live.

*How do we know
these animals
walked?*

The oldest amphibian footprint found preserved in sandstone which tells of a beach promenade of the heroic land and water dweller, is nearly four inches long. The amphibian that made the footprint was probably about three feet long himself. The footprint is that of a right foot with two well-formed toes. The signs of a third and fourth toe are seen but these are not quite formed.

*What are the
amphibians of
today?*

The frogs, the toads, the salamanders—the ugly creatures that walk with turned out feet or that tumble into the water and swim with an ungraceful paddling motion, are all the distant relatives of the first fish that walked. Like the early amphibians these twentieth century ones cannot shake off the spell of the water.

They live near it. They return to it to lay their eggs. They begin life in it as wriggling and fishlike tadpoles.

The largest amphibian reached a length of fifteen feet or more. This creature was an exception to his kind, for most amphibians were smaller in size. These smaller ones looked like

*What were the
ancient
amphibians like?*

*Reptile-like creatures left the water and began life
on land*



salamanders, though some lost their limbs and resembled snakes. A few developed strange horns at the sides of their flattened skulls. They were of widely varied habits. Some in spite of their well-developed limbs probably spent most of their time in the water. It was only the more adventurous ones that became land-dwellers.

*Why were they
chained to
the water?*

The amphibians were chained to the water because they always had to return to it when the time came to lay their eggs. The eggs were soft and unprotected and would have been easily destroyed on the land. Besides the baby amphibians did not come out of their shells ready for life on the land. In order to become a land form they had to change from a tadpole to an entirely new body.

*Why was the
amphibian
a failure?*

The amphibian was a misfit. It belonged neither wholly to the land nor completely to the water. It was born in a stream but it did not live there all the time as a fish does. It had acquired the "land habit" by its slow trips from pool to pool and yet when it was on the land it was forever seeking the water.

A misfit that belongs to neither one thing nor the other is rarely a success. This is why the amphibians died out as a class. When climate changes caused the lands to grow dry and the streams to disappear, the end of the amphibians had come. They might be able to live until they were old and it was time to die, but they could not pass on their life because there was no water in which to lay their eggs.

But the courageous land-dwelling amphibians had made their contribution to the progress of life. They were the first creatures with backbones to live on the land and they were the beginning of a line of life that has been the ruling one ever since in the kingdom of creatures of the world.

They passed on their best qualities to a new creature that followed after them and was much more fitted to live on the land alone than the amphibians had been.

From this time on, beginning with the dwellers of the land, the story of life becomes an exciting one. Each new kind of life is more

startling that the last. Each new kind is something like the life that went before, and something like the life that followed later. The weaker lines vanished and the stronger ones endured.

CHAPTER V

THE GIANT MONSTERS

AND now for the first time an animal that belonged completely to the land made its appearance. It was born on land—from hard-shelled eggs hatched there instead of in the water. It was an air-breathing creature with no sign of gills and from the very beginning of its life was independent of the water. This set it apart from every other creature that had lived in the early world.

What creature first lived on land only?

This new animal was called a *reptile*. In many ways it was like the *amphibian* which had never left the water entirely. The first *reptiles* were probably clumsy, slow-moving creatures with very short legs. But these were soon followed by a striking class of beasts called “ruling” *reptiles*, because they were the most important group of animals in their time. They used their hind legs, and became swift run-

ners. After a time they learned to stand up from the ground as their back legs grew stronger.

*What were the
reptiles like?*

The giant monster reptiles are the most amazing animals the world has probably ever known. Some of the reptiles were smaller



The diplodocus was eighty feet long and ate from the bottom of swamps

than the tiny lizards of today, but others were larger than any animals that are now alive. If it were not for the Stone Book we might not believe the stories of these monsters. But buried in the rocks, where men have found

their bones, are the proofs that these great reptiles once lived and roamed the land.

The reptiles took many forms as time went on. Some went back to the water and changed into shapes and forms that were best fitted for the life they had to live, on both land and water. Turtles and crocodiles are examples. Others entered the great seas and became creatures that might be called sea-monsters. They were lizard and serpent-like creatures of enormous size. And last of all there were reptiles of the air, that after a time developed wings with which to fly.

From the ruling reptiles came finally a land reptile called a *dinosaur*, which means "terrible lizard." However, not all the dinosaurs were terrible. Some were small and ran about swiftly on their hind legs. But gradually they increased in size until at the end of their rule they were tremendous monsters. Some of them had skulls five feet long, and saw edged teeth a foot long, with which they attacked and devoured smaller creatures. In the state of

*What were the
giant land reptiles
like?*

Wyoming the fossil remains of one of these tremendous creatures has been found. It was more than thirty-eight feet long and stood over



Some of the dinosaurs were tremendous in size and had enormous jaws

eight feet high. It had a stiff tail standing straight out, and jaws so wide that it is thought its victims were swallowed whole. The arms and feet had powerful claws, like those of an eagle, only much larger.

Most of the land reptiles had heads that were quite small when compared with the size of their bodies. They had thick and strong hind legs on which they walked. Their tails were thick and long, like those of a lizard, in order to balance their bodies as they moved. Many of them had very short front legs, or arms, which they carried close to their upright bodies.

Sometimes the hind legs grew very long. One dinosaur has a name that means "he who walks on stilts," because of his very long legs. Other dinosaurs walked on all four feet, for they were very heavy monsters. To support their great weight the legs were sturdy and straight, like the pillars of a building. One of them measured over sixty-six feet long, and probably weighed about thirty-eight tons when it was alive.

The Stegosaurus looked horrible but ate vegetables and was probably peaceable



Another one had a tail ten feet long. It may have used its tail like Siegfried's dragon, Fafnir,



Many of the monsters were so tall they had no difficulty in eating tree-tops

who lashed it in all directions, uprooting trees and capturing its victims.

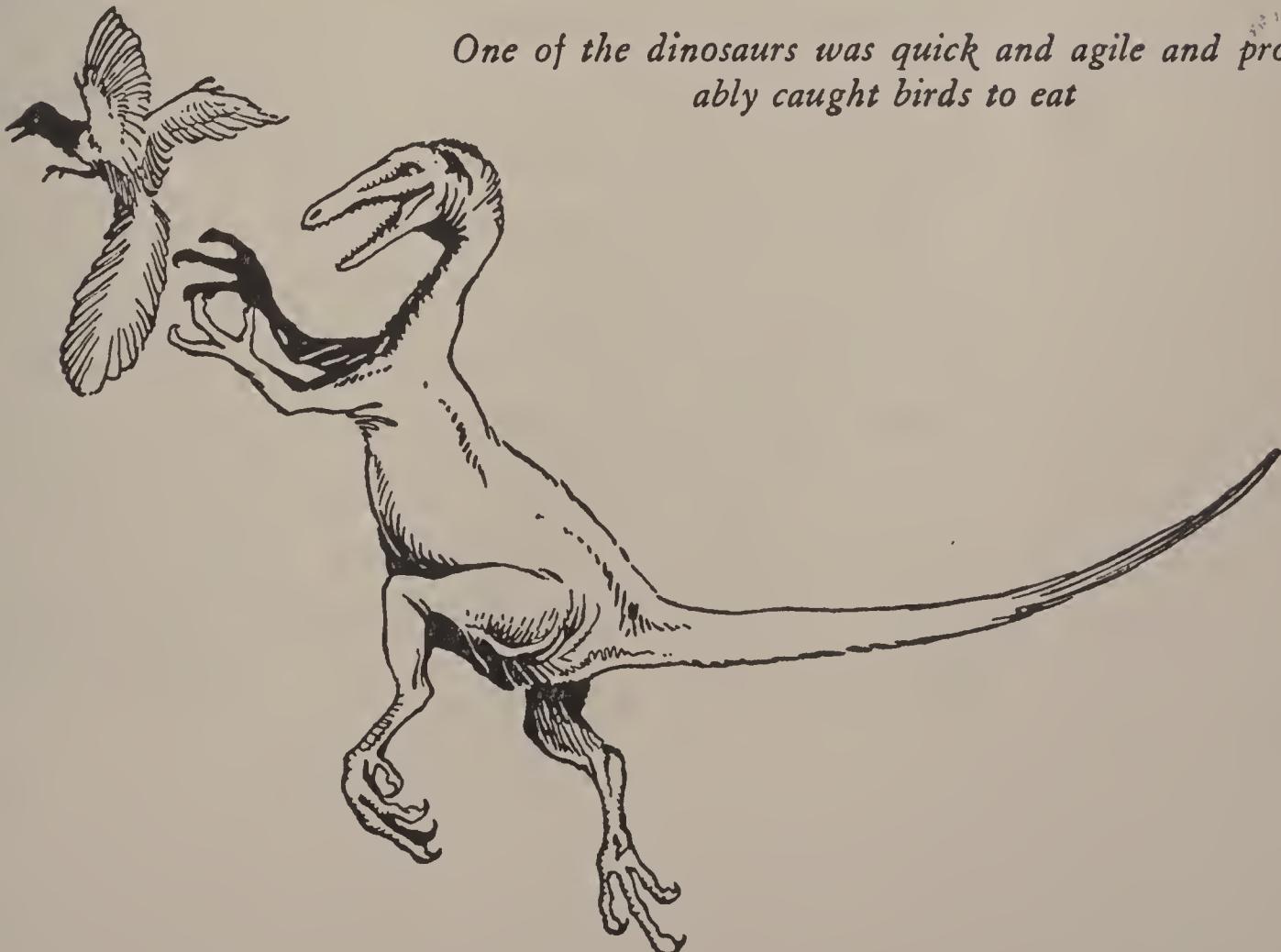
The longest dinosaur that has been found in the fossil records of the earth measures eighty-

seven feet, but this includes a very long tail. Another one that measured eighty feet was probably bulkier, for it had scarcely any tail.

One of the tallest monsters had a long neck like a giraffe and could easily have looked down at the roof of a four story building.

“Bird robber” is the name given to one of the dinosaurs. This creature was not large—perhaps seven feet long with the slenderness of a setter dog. It had long slender fingers without claws. It is thought that it may have lived upon birds or even fish. At any rate its bones

One of the dinosaurs was quick and agile and probably caught birds to eat



tell us that it was quick and agile, and could probably snatch birds. The other big and slow dinosaurs plodded along on their enormous legs unable to keep up with the "bird robber."

The "duck-billed" dinosaur had a mouth with a long flat front and the back part filled with many teeth. The last of the duck-billed dinosaurs is thought to have had more teeth than any other creature. These animals were about thirty feet long and could probably move about not only on the land but in the water for they had a tail that must have been a great help in swimming. The hands were webbed, like the feet of a duck—another reason for thinking they could move about in the water.

The armored dinosaurs walked on four feet and carried great rows of thick plates on their backs. Some of the plates of this horn-like armor stood up like the combs of roosters, and was so hard that none of the other animals could cut through it, either with their horns or tusks. This armor was probably something like the shell of a turtle.

The most astonishing animal of all the armored dinosaurs must have been the one that was hump-shaped. Along its back were two rows of terrible horn-like spines, each of them about twenty-five inches long. This animal's skeleton shows that its tail and hind legs were very strong, so it is quite likely that the creature protected itself by means of its spine-like back and attacked its prey with its hind legs and tail. It must have weighed more than the largest of living elephants, but it had a tiny brain. In fact, its brain was so small that scientists say that it knew about as much as a three-weeks old kitten.

There were other larger armored dinosaurs, one looking rather like a rhinoceros, from twenty to twenty-five feet long. This one had a large head, but most of the others had small ones. The head had horns and the mouth was a cutting beak something like that of a turtle. This creature must have been a terrible enemy because of its tremendous strength and heavy armor.

Most of these creatures with enormous strong bodies, had small brains. With small brains they could not protect themselves by their cunning and so had to rely on their armor. This meant that gradually the ones with the poorest armor all died and disappeared and toward the end of the dinosaur period most of the ones remaining were those which had heavy coverings of bony armor.

*What were the
giant sea monsters
like?*

In the sea there were also giant reptiles, some of them shaped like fish. They had heads formed in a pointed beak to aid them in catching fish. The end of their backbone formed a part of their shark-like tail and they had a fin on their back as fishes have. The limbs that were once suited to the land now became paddle-like. Probably these sea monsters did not stir out of the water, even though they were air breathers.

Another kind of sea monster did not use its tail to help it swim, but moved its limbs like long oars, thus rowing itself along. It had a long, snake-like neck and head, powerful jaws

and many pointed teeth to snatch at the creatures that were its prey.

Although some of these sea creatures must have measured about thirty feet from snout to tail, they did not become as large as the land



Great sea monsters lived in the water and preyed upon the fish

reptiles. Our own whales of today—though not belonging to the reptile family—are bigger than most of the sea monsters of old.

There was another kind of sea creature that was much more fish-like than most of the reptiles. It was probably descended from the four-legged land reptiles that became used to

the water. It was like the porpoise among the living whales of today, though the two are not related.

The sea reptiles did not have as many different forms as the land reptiles did. They had a single kind of life, in water, to which they adapted themselves, while the land reptiles had to become used to many different living conditions. Perhaps certain of the land monsters that could swim should be included in the sea-monsters, too, such as the duck-billed dinosaurs.

Reptiles today, as well as years and years ago, wear out their teeth and replace them at once. They carry an extra supply in their jaws. A certain dinosaur had a supply of nearly four hundred teeth in his lower jaw. It is such teeth—sometimes nearly five inches long—that tell most of the fossil story of the sea monsters.

The great dinosaurs were scaly and armored. Probably the scaled dragons of fairy tale and legend owe their beginning to the scaly horror of the great lizards. Other reptile forms had horns and bony protections around the eyes.

*What is the
strange fact about
a reptile's teeth?*

*How did the giant
monsters protect
themselves?*

Certain ones had tails that could be lashed about like an extra leg. Their teeth were fearful saw-edged weapons of the cruellest sort. Perhaps their greatest protection was their giant size—for what other creature could battle them and hope to live?

Why, then, did they die? Greater than all other forms on the earth then, and never equalled in size since, why did these enormous creatures perish?

No one knows exactly why these great reptiles disappeared. Perhaps they ate all things big enough to be eaten and then turned upon one another to satisfy their terrible hunger. Perhaps they destroyed each other in fearful battles, with a clashing of horns and bony armor and a grinding of great teeth. Perhaps they died as a race, just as a single thing dies—because it is time to die.

The last of the great monsters were old, very old. Some had no teeth. Others had reached such great sizes that they lay in the swamps like great lumps of rock. It is most probable that

*Why did they
disappear from
the earth?*

death came from natural causes and not from some great battle between them.

The land was constantly changing, and as the seas sank lower and the lands became higher, the inland seas and swamps were drained by streams running to the seas. In and around these inland swamps the dinosaurs had lived, and when the swamps disappeared their homes were blotted out. This great race of fantastic giant monsters could not become used to new living conditions. And so, it is supposed that, one by one they died in slow glory, with their record well preserved.

Many of the reptiles spent their time lying in the swamps and rivers



CHAPTER VI

THE REPTILE THAT FLEW

THE reptile family had one more part to play. They did what every human being has always longed to do since childhood—they learned to fly.

What were the flying dragons?

Certain of the reptiles had a bat-like wing and hollow air-filled bones which made them able to fly. And this was true flying, not just gliding. There have been other flying reptiles since but they should really be called “gliding reptiles.” The gliding reptiles float downward in a slanting line when they fall from some height, like airplanes with the engines shut off. True flying is more than this—it means the power to rise from the ground and to stay in the air, if only for a few moments.

This ancient group of flying reptiles—sometimes called the flying dragons—could do this. It is believed that some of them could fly for

quite a distance, for their fossil remains have been found far inland from the ancient shores where they lived.

What were their wings like?

Their wings are thought to have looked like the wings of a bat, for they were formed of skin and not of feathers like the wings of a bird. This piece of skin was stretched on each side of the body, and reached from the arms to the little hind leg. One great long finger held the wing in front. This was one difference between the flying reptiles and the bat of today. The bat holds its wing by three fingers. The reptile's long finger was its fourth one, and the other three were too small to be of any use. Our fourth finger is our *little* finger, but the flying reptile's fourth finger was quite the opposite.

How big were the wings?

The flying reptiles were of all sizes, from the size of a sparrow to that of a baby airplane. Sometimes they were as truly monsters of the air as the giant reptiles of their family were monsters of the land and sea. Fossil records show wings of different sizes. In one the wings measure eighteen feet from tip to tip. Prob-

ably the largest one had wings nearly twenty-eight feet across. The Stone Book has captured some fine specimens for scientists to study.

Most of the new forms of life had come from some simpler form that lived just before. The animal with the foot had come from the animal

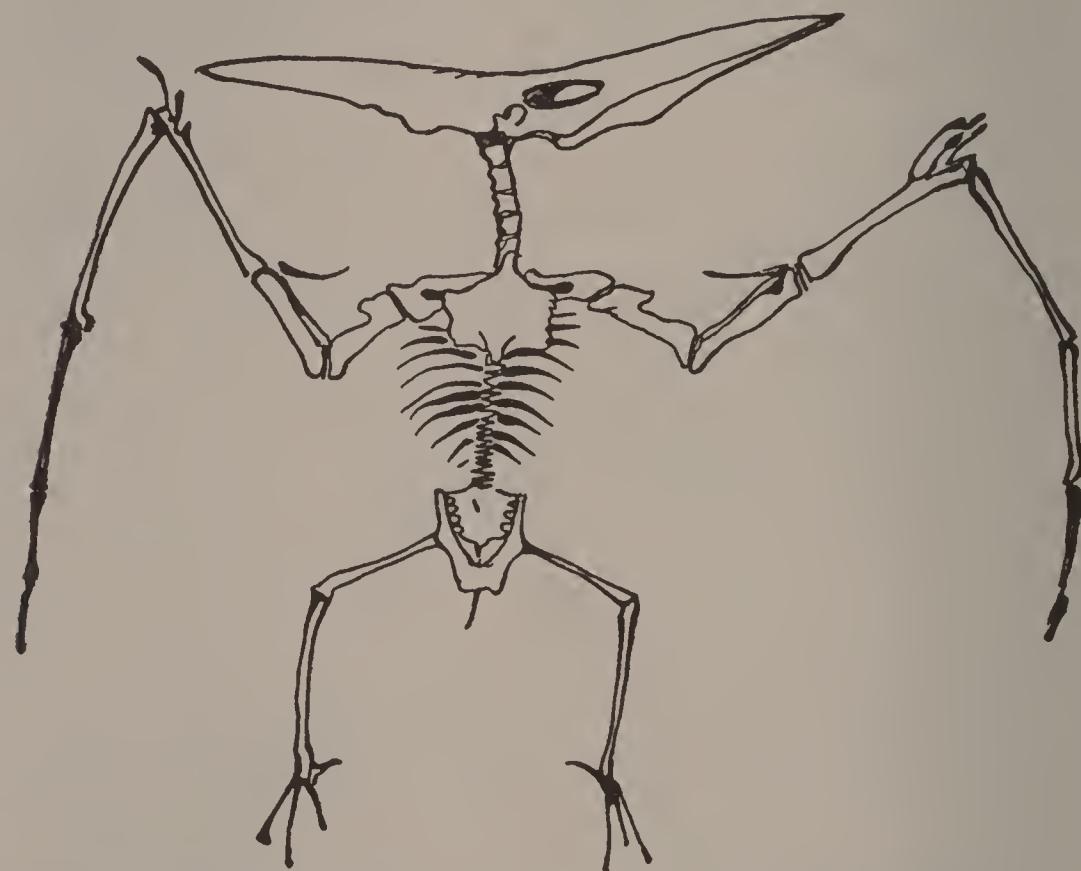
*What is the
mystery of the
flying dragons?*



*There were flying lizards that had wings something
like those of bats*

with the strong and bony fin. For a long time scientists puzzled over the question of the wings of these reptiles. They could not see how

the reptile with a wing came to live, for they could not find any fossil records of reptiles that had the beginning of wings. The wings of insects and possibly of birds came from something



The skeletons showed that they still had fingers on the wings

like a fin that was first used for swimming. But the wings of the flying reptiles and later, those of the bat, seem to be entirely different. Probably in the beginning of things there was

some form of life from which these two winged things came. But that was so long ago that no record has ever been discovered of this unknown ancestor of flying creatures.

The fossil records that men have found of the flying reptiles show that they first appear in their fully developed form, with complete wings. Any later records merely mark changes in size or physical traits, as the loss of tail and teeth. They must have been remarkable spectacles as they swooped through the heavens, casting shadows with their immense wings. What strange fate had made them dragons of the air instead of the seas or the lands? The Stone Book keeps the reason a mystery. But far back in the past there must have been some form about which we know nothing. Did it have wings or only the beginnings of them? Did it learn to fly by accident or to escape enemies on the ground? These are all things to wonder about. Whatever it was, it gave the gift of wings to a line of life. After the flying dragons, the birds were to come. Somewhere in the

shadows of the past hides the dim ghost-like form of the first creature that learned to fly through the air and gave rise to all flying things that came afterwards.

Like the other giant monsters of the land and sea, the flying dragons disappeared from the world. Like them, it is supposed that they died when their race was no longer fitted to the conditions of the world. Whether they grew weaker or simply got old and failed to start new life, we cannot tell. We only know that there are no flying dragons darkening the skies today.

CHAPTER VII

THE FIRST BIRD

ONE of the distant ancestors of the bird was probably some reptile form. Scientists have not quite agreed upon the exact form. Some believe it was a dinosaur-like reptile, because the walking dinosaurs left foot-prints very much the same as the first bird's footprints. The dinosaurs often walked on their hind legs in a bird-like way and they had three toes, like a bird.

Who was its great-great-great grandfather?

Other scientists believe that the bird was a distant cousin of the flying reptile, and descended from the same creature from which the flying reptile came. At least, the great men who have studied the history of bird forms have nearly all agreed that it was probably some Ruling Reptile that was the ancestor of the bird. But just what animal was the bird's ancestor has not yet been discovered.

How did the bird take after its ancestor?

Some of the first fossil records of birds are so like reptiles that it is hard to tell which group they belong to. One great scientist said that birds were "glorified reptiles."

Birds first appeared in the same age when the great dinosaurs ruled the earth. The world was still covered with great plants that would be unfamiliar today. The forest as we know it today had not yet appeared but was soon to come. The climate was still very moist. A fossil of one of these ancient reptile-like birds shows that it was quite like the reptiles in many ways. It had a long tail like a dinosaur, but with feathers on each side. Men think that feathers were a changed sort of scale, which was what the reptiles had. The first birds had teeth, like the reptiles—though the birds of today no longer have them. The wings had feathers but it is plain to see that they were like the arms of the dinosaurs. The clawed fingers were separate, and were like those of the lizard-like reptiles. The first bird to leave a fossil record was about the size of a pigeon.

The main difference between the bird and the reptiles is, of course, in the wings. The bird was to live its life in the air and it was well fitted to do so. Besides having wings, it had hollow

How was it unlike its reptile relatives?



The first of the birds were not expert flyers, but they were like our birds in many ways

bones filled with air, while most other creatures had bones filled with marrow. This made the bird lighter and it could fly easily. Scales probably turned to feathers to keep the bird warm

in its flight through the cool air. Most of the reptiles are cold-blooded, but birds have warm blood. Some of the dinosaurs were thought to have had warm blood, but we know the birds had to have warm blood so that no matter how chilly the wind the bird could keep comfortable. The forelegs of the bird were changed to wings. The first reptile-like bird had teeth, but the fossil records of the later birds show that gradually the teeth changed to a horny bill.

*What were some
of the ancient
birds like?*

Fossils show that some of the birds lost their wings. They were like the penguins of today that swim with their fore-limbs. They swam so well that they did not need their wings at all, and after a time the wings dwindled away. One of these great swimming birds was four and a half feet long. It was a splendid diver, like the loons of our time. It is thought that this bird was covered with soft, smooth feathers. The bird's legs stood out like a remarkable pair of oars, and not like the legs of other swimming birds which kept their feet beneath them like a duck or goose.

One monster bird with wings has been found in South America. It must have stood about twelve feet high and have been like a tremendous vulture. Thus we see that the birds, too, reached giant sizes. Many of them endured



Some of the monster birds lost the power of flying and lived on the ground

for a long time. Fossils of a late date in history show that there were giant birds in New Zealand and other parts of the world.

Some of them laid eggs of tremendous size. It was probably these great birds that account for the story of the roc that Sinbad the Sailor

tells in the Arabian Nights. This is what he said:

“By this time the sun was about to set, and all of a sudden the sky became as dark as if it had been covered with a thick cloud. I was much astonished at this sudden darkness, but much more when I found it occasioned by a bird of monstrous size, that came flying toward me. I remember that I had often heard mariners speak of a miraculous bird called the roc and decided that a great white dome of immense height that I had seen must be the bird’s egg. As I saw the roc coming, I crept close to the egg, so that I had before me one of the bird’s legs, which was as big as the trunk of a tree. I tied myself strongly to it with my turban in hopes that next morning she would carry me with her out of this desert island. The bird flew away as soon as it was daylight and carried me so high I could not see the earth and she descended with so much rapidity that I lost my senses.”

What has been the progress of birds?

One of the most interesting things about birds is that little change has happened to them since

prehistoric ages. Once the bird lost its features like the reptile it remained very much the same as it is today. There are very few fossil forms of birds compared with those we have of other forms of life. Probably this is because they were so light that if they fell into the seas, they would float for a long time instead of sinking to the bottom and forming fossils. If they fell on land, they would decay and probably animals would devour them. But the fossils that we have found show them to have been quite like our modern birds.

Probably the reason was because the birds quickly fitted themselves for their life in the air and adapted themselves so perfectly that no change was needed.

The bird fitted itself to its life of flight so well that it was able to travel with great speed through the air and to fly to great heights.

Tests have been made of the speed of birds today. And we can believe that the flyers of the early world were much the same as those today. The speed record of birds was made by

*Is the bird better
than the airplane?*

a house swallow which flew thirty-two miles in twelve and one-half minutes. This is at a rate of one hundred and fifty-three miles an hour. Vultures can rise from seven thousand to fifteen thousand feet, and one man reported seeing a bird fly above Mt. Chimborazo which rises 20,498 feet into the sky.

Even common birds like geese, storks or plovers, can hold speed records that compare with those of ordinary airplanes.

CHAPTER VIII

THE SMART LITTLE ANIMAL

*“—there in distant forests, where
The little fur-clad creatures fare,
Shrill cries of torture rend the air!”*

*James Beebe Carrington**

THE old order fadeth”—and a new one takes its place. This is—to some extent—the history of the story of life. Most of the great reptile forms were to die. The lords of the line—the sea and land monsters and the flying dragons were blotted out. A new type of creature was to rule the world of living things.

Most scientists think that the new form of life had some reptile for its distant ancestor. This newcomer was on earth at the same time as the giant dinosaurs, and probably before them. But it was such a small form of life and so unimportant that it mattered very little. This

*What new form
of life made its
appearance?*

*From Anthology, "Poetry's Plea for Animals," Lothrop, Lee & Shepherd.

creature was called a mammal. It was warm-blooded, very active, and it nursed and watched over its young.

The mammal-like reptiles that appeared with the other reptiles, far back in time, were four-footed creatures that could run swiftly and actively. They were about the size of a squirrel. They had legs underneath their bodies, something like those of a dog, and not the sprawled out limbs that the reptiles had. But they were still reptiles in many ways. Fossil remains of their jaw bones tell us this. Their teeth, though, were placed in their mouths in much the same way as the mammal's teeth. They were not as long-lived as the other reptiles. But they probably left, as their descendants, the earliest of the real mammals of the earth.

This first little mammal was completely in the shadow of the giant reptiles. The fossil remains tell us that they were small creatures and had tiny jaws so probably they lived on insects. There was not a chance in the world of the early mammal's even trying to match the

What was its reptile relatives like?

Who was the "underdog" in the Age of Reptiles?

strength of the sea and land monsters that reigned supreme.

But the mammals had something to make up for their weakness. They had brains. Other creatures before them had brains too, but they were so small that they were almost useless. Even the greatest reptiles had brains that were tiny compared to the size of their great bodies. The brain of the mammal could grow and it did, far beyond that of the other creatures.

In what way were they superior to the reptiles?

The first mammals were little things and had to hide from the great reptiles



The reptile knew practically nothing, but the little mammal had a brain that could learn things by experience and it could remember. The reptile moved about like a mechanical beast—but the little mammal was alert and watchful. This is probably why the mammals were not destroyed by the reptiles. They knew their enemies, were quick, and had sense enough to run away from them.

We can see why the mammals stayed alive—because they moved swiftly, and because they stayed small in size. Little ones could hide easily in the thickets, but the larger ones would have been easy prey for the great monsters.

When the giant reptiles began to die out the chance came for the mammals to develop into something larger and more important.

The mammal was the perfect mother to its young. Among the other forms of life, particularly among the reptiles, the parents paid no attention to the child. A young reptile could not really ever be young. It was born grown up. Its mother deserted it at once so it had to

*Why was it that
mammals "grew
up?"*

be born all ready to take care of itself. Except for size it was entirely developed. When it came out of the egg it was a tiny imitation of its parent.

But the mammal was a baby for a while. Its mother nourished it. At birth it was not fully developed but changed and grew just as a baby today changes in more ways than size alone. At birth the brain was smaller than later on. The time had come when a creature could develop its mind.

For countless ages the mammals had been the underdogs in an age of reptiles. They changed somewhat and fitted themselves for the life they had to lead. They saved themselves by their quickness and their brains for the time that was to come when they would rule the earth in place of the reptiles. At last they became something more than just a few scattered animals—they were a class by themselves, looking like nothing else in the world, acting like no other animals—a type of their own, and ready to start upon their conquest of the world.

How did mammals prepare for their conquest?

How did the mammals get ahead of themselves?

As soon as the earth was free of the giant monsters of the reptile family the mammals began to develop very fast. Great beasts arose. But as they grew they lost the most valuable thing they had. Their brains stood still and did not develop with their bodies. The first mammals to become creatures of good size did not have as much chance of living a long time as the small mammals that had lived before them. The history of life was repeating itself. The first mammals to rule the earth were like the giant lords of the reptiles. They were supreme because they were big, and not because they had brains. And size alone was not quite enough.

In growing big they did not develop in certain other ways that were very important to them in their struggle to live. Some of them lost their swiftness and became awkward, so they could not escape if they were pursued. Their teeth were the grinding sort that were not suited to all kinds of food. They were certain to die out in time for they were not well fitted to live.

They were too large in body. They could not feed themselves in a way to keep their great bulk alive. They had not enough brain power to care for and protect their offspring. If it had not been for other animals that did not grow so large, and developed more sensibly the whole line of mammals would have vanished.

One of these great stupid beasts was about the size of an ox. It had heavy short legs and spreading feet that tell the story of life in a swampy place. It had an ugly head which was flat on the top and seemed almost a part of the body itself. It had teeth like the tusks of a boar.

Another stood seven feet high and had several pairs of horns, some of which were eight or ten inches high. Its legs were like young tree trunks, straight and thick. It was perhaps

*What did some of
these mammals
look like?*

*The last of the dinosaurs looked a
great deal like a rhinoceros*



most nearly like the modern elephant. Its teeth were curved like sabers, or else spear shaped. It was well armored with its horns and its tusks and its great size, but it had a tiny brain. The more intelligent animals about it marched on to future life, while these stupid animals soon perished.

*Who were the
invaders that came
to stay?*

The Stone Book tells us of an invading host of new mammals that are called modern mammals because they are the direct ancestors of so many of the animals of our own world today. Some of them were the forefathers of the hoofed animals. They were the ancestors of the even-toed horses and rhinoceroses, and the uneven-toed camels, deer and swine. In this group were the ancient mammoths and mastodons, members of the elephant family. There were pouch-bearing animals that were to

*Great horned mammals came that were too big and
stupid to continue life*



have kangaroos and opossums for their descendants. There were toothless sloths, of which the armadillo is a connection. Then, too, there were winged creatures like the bat;



The Irish Elk was of tremendous size with great branching antlers

gnawing animals that became rats, mice and hares; flesh-eaters that later were to branch out as dogs, cats, bears, seals; and whales and sea cows; and countless others.

Finally, and most important of all, came a group called Primates, meaning First among all things, and this group included moneys, apes and Man himself.

The two most interesting stories of the modern mammals are the tales of the development of the elephant and the horse. The stories of the other mammals are stories that follow the same pattern. They show that step by step the creatures became more highly developed through the ages. It is a fascinating thing to watch the changes and the resemblances in one family as we trace them down through the long years.

*What happened to
the little horse?*

The first record of the horse is from a fossil that gives us a picture of a little animal that must have looked like a toy steed. It was only about twelve inches high. Its other measurements would lead us to think it was about the size of a fox terrier. It had four toes on its front feet and three in back. It did not have the graceful long neck that later horses had. Its head and neck were short. It had an arched back that made it less clumsy than the other mammals that had backs that did not curve.

But the little horse was to change into a higher form. It began to grow larger as ages

went on, and its legs became longer and more slender. The second stage shows that its teeth changed somewhat so that it could graze better.



*The first horses were not much larger than fox terriers
and had four toes*

It lost a front toe so both front and hind feet had but three toes. It had started on its way to become a steed for men to ride upon. It had to pass through many more stages before it reached its present stage. With each new stage

it changed. Its toes grew smaller and finally disappeared, except one great toe on each foot—the hoof. Soon it was as large as a wolf, then a sheep, and so on until finally it became the large animal of today. Of course, each one of these changes took many, many years, and countless horses lived and died in the gradual process of change.

*"The elephant, with mighty tread
This strange procession fitly led."*
August Larned*

*What is the
elephant's history?*

If it were not for the elephant we would have no idea of what a great beast looked like in prehistoric times. The elephants, since the death of the dinosaurs, lead the kingdom of beasts in size, sharing honors with the whale. There is something about great size which captures the interest of us all. There is something awe-inspiring in the sight of a creature so many times bigger than ourselves.

The ancestors of the true elephants lived in Africa. They walked on four feet and stood

*Anthology "Poetry's Plea for Animals," Lothrop, Lee and Shepherd.

about three feet high at the shoulders. Their thick necks were long so they could put their heads down to the ground. Their heads were not like those of the elephants we know, for



The ancestors of the elephant had long necks but their trunks and tusks were short

they had the shortest kind of a trunk and tusks. But they had a good brain, and it is not surprising that they became important later. Just as the horses grew bigger and did most of their changing in their feet, the elephants grew bigger

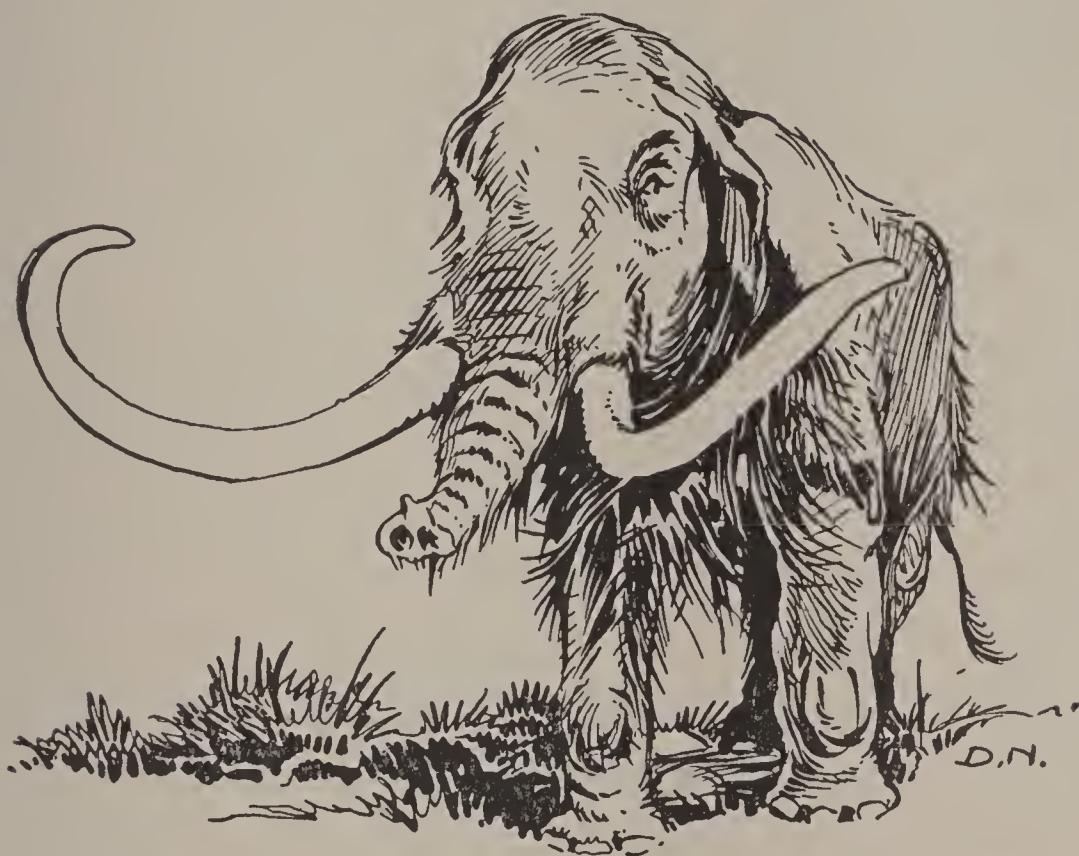
and developed the great jaws that were to support their trunks.

There is a page missing in the history of the elephant, and no one knows just what happened to the elephants for a long period. But all during this time the lower jaw must have been growing. Fossils of these later elephants tell us that they had enormous jaws and the beginnings of trunks.

During the stage when the elephants were developing there were some curious creatures of this family. None of them have lasted. One was called the Dinothere, which means terrible. These animals had long sloping faces and downward curved jaws with tusks. They were giants in size. The mastodons were early members of the elephant's family. They were from seven to nine feet high and stockier than the elephant. Some of them had shaggy hair of a dark, golden brown color. Another member of the family was the mammoth, with its woolly coat to protect it from the cold Arctic climate. This mammoth has been seen by

men, for marvelous specimens were frozen in the soil and the ice itself.

The direct ancestors of living elephants are not known because no fossil mastodon or



The mastodon was related to the elephant and had long tusks and a long trunk

mammoth yet discovered agrees perfectly with the elephants of today.

Certain mammals far back at the beginning of their existence, turned to the water for their

What happened to the mammals that liked the water?

What happened to the mammals that liked to climb trees?

homes instead of the land. They grew into great fish-like shapes, tremendous in size. These were the far-distant forefathers of whales. No one knows why they turned to salt waters, but they have stayed there ever since and are now so completely sea animals, though they descended from land forms, that if they are taken out of the water they die.

Other mammals were well-fitted for a tree-living life. To walk along the branches, these mammals had to be very agile. Some held on to the bark by digging their sharp claws into it. Others grasped the branch between the four fingers and the thumb or the four smaller toes and the big toe. The sense of sight rather than smell was the highly developed sense in this tree-climbing mammal known as a *primate*. Ages and ages after the first tree-climbing mammal, rose the branch of monkeys which are such an amusing and intelligent type of creature. The monkey walks on four feet like his distant ancestors, but he can sit on his haunches. Grasping a branch in his tree home

was perhaps the beginning of the monkey's use of his front feet as hands. With the hands and with good eyes and a fine brain these tree-living



The tree-living mammals soon became of the highest types of animals

mammals became one of the highest types among animals.

What happened because the ape was bigger than the monkey?

About the time that monkeys made their appearance, fossils tell us of another form that were perhaps descended from somewhat the same type of mammal as the monkeys were. This form is the ape. The most important thing about the ape was its size.

The monkeys were light enough to run along the branches of the trees without danger of falling, but the heavy apes could not let all their weight fall upon the small limbs of the tree. So they acquired a strange way of traveling through the forests. They swung themselves from limb to limb. And so were in an upright position most of the time instead of on all fours. This started the marvelous possibility of an upright position on the ground.

Why was the ground-walking ape important?

The higher forms of apes began to return more and more to the ground. They probably walked poorly. The ape was stooped and its arms were too long because they had been used to swinging on trees for a long time. This walking ape plays one of the most important roles in the whole cycle of life.

CHAPTER IX

THE COMING OF MAN

THIS is a question that scientists ask one another time and again. No one has settled the matter as yet. One of the most important finds that has been discussed as the "missing link" is the skeleton of a man-like creature which scientists call the Java "ape-man." The remains were discovered in Java. They consist of the top of a skull, three teeth and a thigh bone. Do they belong to an ape or an early form of man? Anyone who attempts to read a story of the beginning of man from this small part of a skeleton would seem to be attempting something impossible. And yet certain facts can be found out. The size of the thigh bone tells us that the creature was the size of human beings. Its shape tells us that it walked erectly. The top of the skull shows a brain larger than any found in any known ape, but a brain much

Has the missing link between ape and man been found?

lower than that of men. The forehead is lower than a man's and the ridges above the eyes are more massive than any known man's.

*What is the
"dawn man?"*

In Sussex, England, some workmen digging came upon the skull and jaw of a man-like creature that has been named the "dawn man." The brain is more highly developed than the Java ape man but far less than the brain development of Europeans of today. The speech centers are developed as they were in the Java ape man and the brow is low. The jaw is very ape-like. There was no jaw found with the Java ape-man so they cannot be compared. It is a chinless jaw like that of a chimpanzee. If this creature had the mind of a man it probably had a jaw and face that was yet to change into the form that we know now.

*What was the
Heidelberg jaw
like?*

Finally a jaw was found more like a human jaw. Near Heidelberg in Germany, the sands gave up a jaw with teeth that were more human than they were ape-like. The jaw was more powerful than our jaws but it too was chinless like the jaw of the dawn man.

In China the skull of the "Peking Man" was unearthed. For several months geologists worked to remove it from the mass of hard rock in which it was embedded. Dentist's drills and other very delicate tools were used to cut away the rock. The "Peking Man's" skull was discovered in a quarry near the old capital of China. It has been considered by some authorities to be the oldest fossil of man unearthed thus far.

The skull showed the same heavy ridges as those found in the other primitive skeletons of man.

The skeletons of early cave men tell us of a man who walked with a slight stoop as the apes did. His knees were bent. Other skeletons of his kind were found. These people were apparently short and sturdy, the men about five feet three inches tall and the women four or five inches shorter. Their heads were narrow and they had bony ridges above their eyes, something like the apes. They had broad noses and a long upper lip caused by a protruding jaw.

*Who is the
"Peking Man?"*

*Who was the last
of the men who
bore the mark of
the ape?*

How do men follow the same lines of progress as forms of life?

Who was the "true man?"

They had huge chewing muscles and no chins. Their heads were bent forward on their chests.

Skeletons appear to tell of a man who took over the land from the last of these men who bore the mark of apes in their manner of walking and in their appearance. This new type of man was almost the same as men of today. His brain was of the human type. The ridged brows and the sloping low foreheads had disappeared and his teeth did not protrude. He is called the true man because his body follows the outlines of the human body as we know it today.

Just as we find human beings branching out in many ways, so men can be divided into many races. The countless forms of fish and reptiles and amphibians showed that each new development was likely to form a new type. Man developed in the same way. Belonging to the great unit of life called the Mammals, he is a long step from the "smart little animal."

CHAPTER X

THE CHAINING OF THE ANIMALS

*“Men were on earth while climates slowly swung,
Fanning wide zones to heat and cold, and long
Subsidence turned great continents to sea,
And seas dried up, dried up interminably,
Age after age; enormous seas were dried
Amid wastes of land. And the last monsters died.”*

—*Jack Collins Squire**

WITH the death of the dinosaurs, those brutish monsters of the old world, the animals began to lose their power. A steady decline of animal life began that has continued ever since. The early passing of the animals was caused by great climate changes as well as old age and disease.

The greatest climate changes of all were the long periods of cold in a time called the Age of Ice. Great ice sheets came down and blotted

*Why did the
animals lose their
power?*

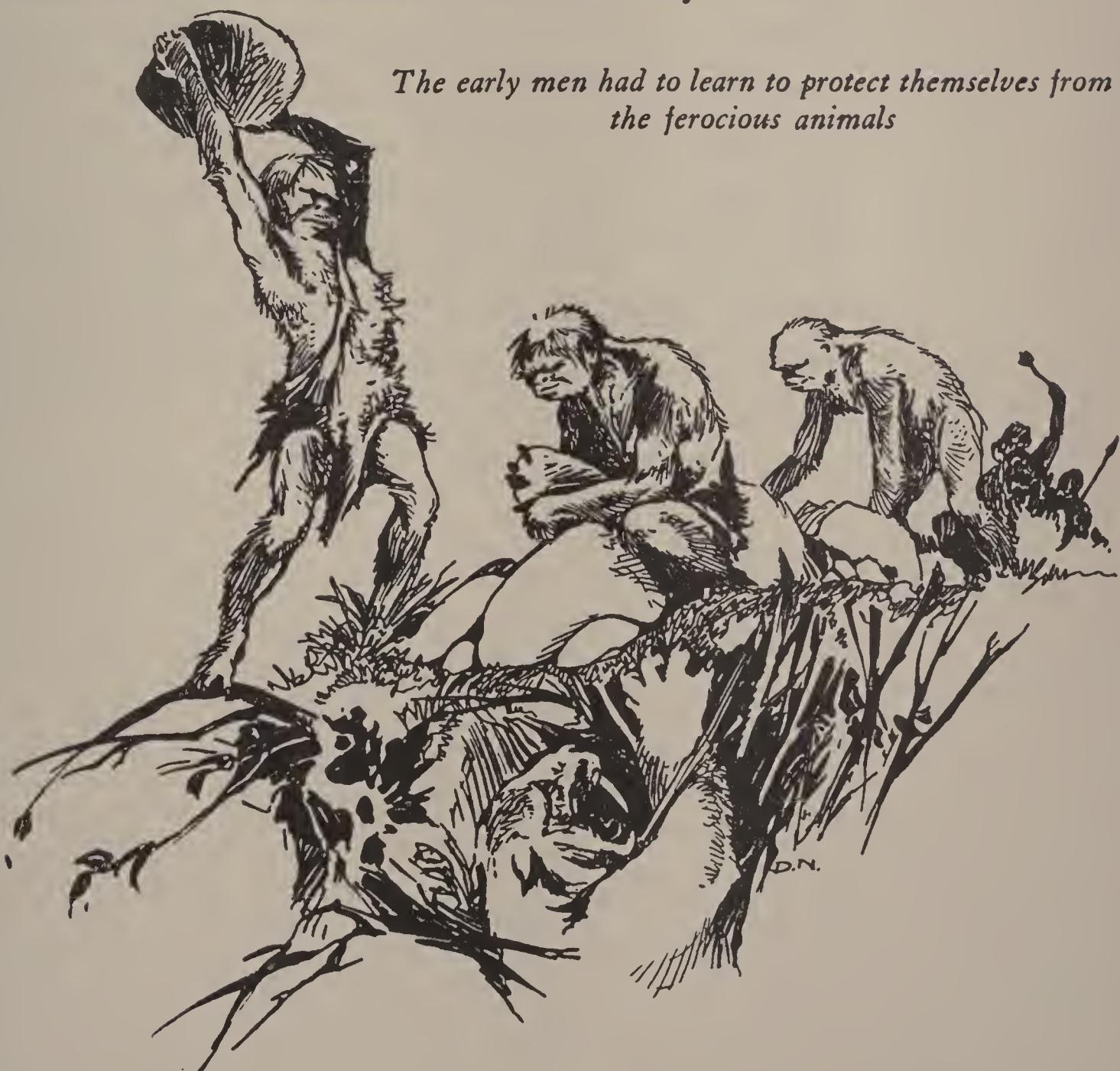
*From “Poetry’s Plea for Animals,” Frances E. Clarke, Lothrop, Lee and Shepherd Co., Boston.

out many races of animals. Warmer periods followed and the ice sheets retreated. Life began again only to be killed when the ice sheets came again. Four times the glaciers covered Europe, wiping out life like some giant cold hand. Many creatures fled southward but most of them were killed. But man remained. Because he was intelligent he knew how to take care of himself and he was able to survive the terrors and destruction of nature. The animals that did remain had lost some of their power in their long struggle to keep alive. The coming of man was the last blow to them. Man was their mortal enemy! Only two ways were open to the wild creatures—to submit and become domestic animals and slaves of men or to be hunted for the rest of their days.

Thus the passing of wild animals is to come about. It is true that some remain—but they are poor creatures compared with the glorious ancestors they descended from. The most thrilling of the brutes that still exist are the elephants, but they are rapidly being killed

off. Only two species remain. The wildest creatures—lions and leopards and other ferocious beasts of the jungle and forest are becoming fewer in number. They could not become tame. It seems perhaps that it is better for them to die in the tangled gloom of deep woods than to walk the streets of men in safety.

The early men had to learn to protect themselves from the ferocious animals



*What of the
future?*

“The old order changeth yielding place to new.” Does this mean that man, too, must leave his place of honor and submit to some greater creature than himself. We cannot know. Like the amphibian that had no hint of a life to come as it lay in its stupid half-dead state, man cannot see through the mists of the future. But he is not very much afraid that any other lord will take his place. He has the gift that the smart little animal gave to him—his brain. Like a magic weapon, it shields him from harm by showing him the dangers that threaten him, and like a crown of glory it removes him from all other creatures in this world of life.

APPENDIX

THE AGES OF THE EARTH

The Nuclear Stage—The earth was hurled out of the sun, a mass of gas and fire.

The Stages of Growth—Volcanic action caused by pressure created heat inside the cold earth and gravity increased so that the earth could hold atmosphere and water. Oceans and continents were formed and life began.

ARCHEOZOIC AGE

Period of very ancient times when life appears to have been present though it left few records. Certain Archean rocks have been estimated to be 1,500,000,000 years old.

PROTEROZOIC AGE

Sometimes called the Age of Primitive Marine Invertebrates. A period of very early sea life which left a very imperfect record as the creatures were probably too soft or tiny to create well marked fossil impressions or forms. An age when rock systems formed extensively.

PALEOZOIC AGE

Cambrian Period—began about 550,000,000 B. C.*

Life in the waters, rise of shelled animals, jelly-fishes, corals, starfishes, molluscs, trilobites, shrimp-like forms.

* Geologists several years ago adopted a time table of the ages of the earth based upon Barrell's calculations of the radioactivity composition of uranium found in the rocks. The figures given here are from this time table.

Nothing known of land life. Some vegetation may have existed.

Ordovician Period—began about 480,000,000 B. C.

The first of the armored fish with backbones of cartilage material rather than bone. Rise of woody plants at close of period.

Silurian Period—began about 390,000,000 B. C.

Appearance of first scorpions. Rise of lung fish and development of the armored fish so that they closely resembled the true fish which followed in the next age.

Devonian Period—began about 350,000,000 B. C.

Fish develop so highly, period often called Age of Fishes. The first amphibians or land vertebrates develop. The first known land flora; ferns, seed-bearing ferns, rushes.

CARBONIFEROUS AGE OR LATE PALEOZOIC

Mississippian Period—began about 300,000,000 B. C.

Rise of sharks. Great age of coal plants begins, soft, spongy woods, seed-bearing trees and shrubs of all kinds.

Pennsylvanian Period—began about 250,000,000 B. C.

Rise of primitive reptiles and insects developing to enormous sizes. Vegetation reaches greatest size and variety in this period. Extensive coal swamps.

Permian Period—began about 215,000,000 B. C.

Primitive reptiles developed into lizard forms and long-

spined types. Insects became smaller and more like modern forms. Primitive conifers, modern ferns.

MESOZOIC AGE

Triassic Period—began about 190,000,000 B. C.

Amphibians on the decline. Reptiles developed into dinosaurs on land and ichthyosaurs in the sea. First appearance of mammals of small size. Plant life evolved a new group called the cycads, a fern-like tree.

Jurassic Period—began about 155,000,000 B. C.

Dinosaurs attain greatest size. Appearance of first flying reptiles, the pterosaurs. Rise of first bird. Sea life of leading importance. Great sea-serpents descended from land reptiles, called the plesiosaurs. Mammals the size of rats. Appearance of butterflies. Moderate sized trees.

Cretaceous Period—began about 95,000,000 B. C.

Reptiles nearing extinction. Waning of the dinosaurs. Development of Plesiosaurs to greatest size and strange forms. Birds developed more highly, especially those with water habits. Mammals of higher type coming into being as the pouched mammal. Appearance of flowering plants.

CENOZOIC AGE

Paleocene Period— short period intervening
Rise of archaic mammals.

Eocene Period—began about 55,000,000 B. C.

Mammals developed from "pouch" type to higher ranks and larger sizes. Archaic mammals disappeared by close

of period and primitive forms of hoofed creatures developed into horses, tapirs, rhinoceroses. Small flesh-eaters, insect-eaters, and herbivora. Rodents appeared. Pioneer whale forms. Birds of modern aspect. Forests developed.

Oligocene Period—began about 35,000,000 B. C.
Rise of higher mammals. Modern types of animals developed. Primates were on earth; true whales in existence, insects well established. Vegetation luxuriant.

Miocene Period—began about 19,000,000 B. C.
Notable for development of horses. Ancestor of chimpanzee, gorilla, and man thought to be in existence.

Pliocene Period—began about 7,000,000 B. C.
Anthropoid apes appeared and deserted Northern countries owing to falling temperature. The period of the Java ape-man.

QUATERNARY AGE

Pleistocene Period—began about 1,000,000 B. C.
The glacial period, marked by migrations of life southward and extinction of great mammals. Cave-men developed and became hunters.

Present Age—began about 50,000 B. C.
Rise of world civilization and the development of mental rather than physical life. The Age of Man.

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